represents the Scythian horses, which continued to be of a small size down to Strabo's time, and they were derived either from he tarpan or Prezevalsky's horse. The Mongolian pony, though surefooted and enduring, is slow of pace. Neither China, Siam nor Burmah have any indigenous horse answering to the blood horse. India could never breed horses, says Marco Polo, in whose time India was supplied either with Mongolian ponies from Yunnan or with Arabs from south Persia, Aden and other Arabian ports. These Arabs fetched enormous prices, equivalent to 200*l.* It has hitherto been universally held that Arabia is the original home of the blood horse. This is a baseless assumption. In the Old Testament, the Arabs are never mentioned as riding anything but camels and asses. Though the author of Job knew of the war horse, yet Job did not own a single horse, his equine possessions consisting of 500 she asses. Herodotus (vii. 87) enumerates the nations (including the Libyans) that supplied cavalry to Xerxes' host, but the Arabs only furnish a camel corps. Agatharchides (cited by Strabo) describes the Arabs as camel keepers.

Finally, Strabo (*flor.* A.D. 1) expressly states that neither the peoples of Arabia Felix nor those of Arabia Petræa bred horses. Naturally, then, Scaurus after defeating the Arab king Aretas put on his coins Aretas leading his camel. It is clear, then, that down to the Christian era the Arabs bred no horses. It is therefore clear that though the Persian kings in the fifth century B.C. bred the largest and best horses in Asia, these were not of an Arab strain. These horses were kept largely in Armenia, and are described by Strabo as similar to the Parthian horses, and as differing from the horses bred in Greece and the other kinds of horses known in the Roman empire. There can be little doubt that they were the same horses as Marco Polo found in great numbers in Armenia (1270 A.D.) known as Turquans, the Turcoman ponies well known in Persia to-day. The Persian horses cannot, then, have been the ancestors of the thoroughbred, though it is quite possible that their superiority was due to their having a cross of thoroughbred blood, for already by 900 B.C. Solomon imported horses from Egypt (1 Kings x.), and "so for all the kings of Syria and for all the kings of the Hittites" Egypt could not breed horses, neither could she have got them from the Arabs, who bred none even 1000 years later. But she could and did get them from the Libyans, who from the dawn of history are masters of the most famous horses. Cyrene sent the best horses to the games of Greece (Pindar, *Pyth.* iv., &c.). It is noteworthy that it was in the same century as the founding of Cyrene that the four-horse chariot and the racehorse were added to the Olympic events. The Phœnician settlers at Carthage found the Libyans using these beautiful horses, and when they struck coins placed a horse or a horse-head on them as the badge of Libya, and used a similar type on their coins struck in Sicily, whither, doubtless, they carried the Libyan breed. This accounts for the extraordinary fame of the horses of Etna and Syracuse and the famous steeds of Tarentum. It is now clear that the Arabs never owned a good horse until they had become masters of North Africa and the Barbary horses, from whom are sprung our own racing stock through Lord Godolphin's Barb. North Africa, therefore, and not Arabia or any other part of Asia is the original home of the thoroughbred.

Now, though the pedigree of the cart-horse type can be traced to the coarse, thickset little horses of Europe and Asia, the wild ancestor of the Barb is yet to seek, for Africa has no wild horse, such as tarpan or Prezevalsky's, though she has an ass and four zebras, including the quagga, now extinct. Can the Barb be sprung wholly or in part from a zebra? Arab foals at birth constantly have zebra markings, sometimes retained when full grown, as by Prof. Ewart's Arab filly Fatima. Strabo, too, notices that the horses of the Libyan Garamantes have longer hoofs than any other horses. Prof. Ewart's hybrids from Burchell's zebra and various mares show the markings, not of a Burchell's zebra, but of a Somaliland zebra, from which it has been inferred that the remote ancestor of both *Equus caballus* and Burchell's zebra was striped like the Somaliland and mountain zebra. But is it necessary to go back so far? May not the Somaliland zebra stripes in the hybrid be due to the circumstance that the dam in each case had a certain amount of Barb blood in her, which was derived from either the Somaliland zebra or a closely allied species? He (Prof. Ridgeway) had crossed a Muscovy drake with a common white duck, derived from the common wild duck, with the result that all the offspring are coloured, and their colouring resembles that of the mallard. No one would say that the hybrids show a reversion to a remote common ancestor of both mallard and Muscovy, for it is obvious that the colouring is simply that of the white duck's immediate ancestors. Authorities like Captain Hayes have pointed out the great similarity in form between Burchell's and the Somaliland zebra to a well-bred horse, *i.e.* a horse that has Barb blood in him. He therefore suggested that the Barbary horse, from which he had shown all the fine horses of the world have sprung, was derived either from the zebra of north-east Africa or, as is more likely, from some very closely allied species, now extinct, which, like Prezevalsky's horse, may have had castors on its hind legs like *Equus caballus*.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

MR. A. S. GREEN has been appointed professor of dyeing at Yorkshire College, in succession to the late Prof. Hummel.

THE University of California is about, says *Science*, to erect a physiological laboratory at a cost of 25,000 dollars. It will be under the charge of Dr. Jacques Loeb.

THE royal assent was given to the Education Act, 1902, on Thursday last. The Act comes into operation, except as expressly provided, on March 26, 1903, or such other day, not being more than eighteen months later, as the Board of Education may appoint. The Act does not extend to Scotland or Ireland, or for the present to London.

BEDFORD COLLEGE FOR WOMEN, London, and the Sanitary Institute have in conjunction arranged a conference on the subject of hygiene for schools, to be held at the College on January 21, 1903. Prof. C. S. Sherrington, F.R.S., Dr. Gow, Mr. Michael Sadler, Prof. Adams and others are expected to speak. Further particulars and cards of admission can be obtained either from the Sanitary Institute or from Bedford College.

THE special committee appointed to consider the needs of South Africa in regard to technical education, with special reference to the Transvaal, have, says the *Chemist and Druggist*, submitted a lengthy report, and state they are convinced that there is a great demand, especially in Johannesburg, for technical education. This demand can best be met, in their opinion, by establishing an institution providing the highest kind of training in arts and sciences. They recommend that all students, before admission to the institution, pass an examination of a standard equal to the matriculation of the Cape University. Complete courses should be provided in the new institution, the committee think, in mining, mechanical and electrical engineering, metallurgy and chemical engineering, civil and sanitary engineering, and architecture.

IN his paper on French rural education, read before the Society of Arts on December 10, Mr. Cloudesley Brereton explained the part taken by the primary and secondary schools in the agricultural education of the nation. In France, in some communes, one person in every four is a land proprietor, and the aim in the primary schools has been to give the pupil some grasp of the principles underlying the science of agriculture. The teacher is not so much supposed to follow implicitly the departmental programme, but rather to choose those portions which best suit his own particular district. There is still doubt in the minds of French educational authorities whether the scientific or the agricultural side of the instruction should predominate in the instruction given in primary schools. The teachers in these schools are themselves trained by professors of agriculture in the training colleges, and though the course of instruction is a good one, it might with advantage be more practical. In the secondary schools of France, agricultural education has an insignificant place, but the work done in this direction by means of lectures and evening classes carried on in connection with old boys' clubs and other organisations is very great.

AN important article, by Mr. W. M. Webb, on the progress and interpretation of "nature-knowledge," especially in relation to the experience gained at the Nature-Study Exhibition held last August in London, appears in the October issue of the *Record of Technical and Secondary Education*. After referring

to the importance of nature-study as a factor in the new education, the author insists on its value as a means of cultivating the powers of observation and at the same time warns his readers that it is not to be considered as in any way identical with elementary science. Various definitions and limitations of the subject are then given, after which attention is directed to its aims and objects. Among these, stress is laid on its power of interesting pupils—especially those to whom the ordinary school-curriculum is peculiarly distasteful—and thus rendering education a pleasure rather than a toil. It is also urged that nature-study promises to be the form of education best adapted to develop the pupils into good citizens capable of making their way in the world and, above all, of relying on their own judgment. Healthful it certainly is, and the love of nature it engenders may, it is suggested, tend to check the exodus of the population from the country to the towns. The difficulty of securing the right class of teachers claims a considerable share of attention, and some amount of discussion is devoted to the question as to the extent to which books should be used. Collecting, again, is a phase of the subject which requires very careful treatment in order to prevent the pupils from degenerating into mere curiosity-hunters. The author is, however, of opinion that both books and collections have their place in the scheme. The relative values of outdoor and indoor work are then discussed, in the course of which much importance is attached to the "seasonal method" of study. Before the final summary, the article winds up with observations on teachers of all grades and classes, and the best method of training them, followed by a reference to the objections against, and the difficulties connected with, "nature-study."

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, November 27.—"The Inter-relationship of Variola and Vaccinia." By S. Monckton Copeman, M.A., M.D. Cantab., F.R.C.P. Communicated by Lord Lister, F.R.S.

The term "variolæ vaccinæ" employed by Jenner, as a synonym for cow-pox, has been generally accepted as affording evidence that, in so naming this disease "small-pox of the cow," he was desirous of placing on record his belief that cow-pox or vaccinia was intimately related to human small-pox, if indeed it were not directly derived from it.

But the difficulty experienced by the writer and numerous other investigators in attempts to transmit small-pox to bovines, whether cows or calves, has not infrequently been cited as a reason for regarding Jenner's theory with distrust.

It is well known, however, that a great deal, at any rate, of the small-pox which was prevalent at the time that Jenner lived and wrote was of that comparatively mild variety which, under the name of inoculated small-pox, was intentionally produced in healthy subjects, with the object of thereby conferring protection against subsequent attack by the disease in virulent form.

So mild indeed, at times, were the results of inoculations in the hands of such operators as Adams and the brothers Sutton, that, as we learn from contemporary records, in many instances but little obvious effect was observed, with the exception of the local vesicle arising at the site of insertion of the small-pox virus. The majority of persons thus inoculated are not likely, therefore, to have been incapacitated, as the result of the operation, to a much greater extent than are those who undergo efficient vaccination at the present day, and, doubtless, they would be, for the most part, capable of following their ordinary avocations during the progress of the induced disorder.

Not only were the effects following on inoculation comparatively mild, but the disease in this form was intentionally carried into many country districts which otherwise might not have become invaded by small-pox.

In the light of these facts, it would appear not improbable that it was from the *inoculated* form of small-pox rather than from the ordinary variety of the malady that much, at any rate, of the cow-pox in the pre-vaccination era was derived. Supposing this to have been the case, it is not difficult to understand how that the cracks, so often found on the udders of cows, might become infected by a milker with fingers contaminated by contact with the inoculation sore upon his arm.

In default of inoculated small-pox in the human subject, use was made of the monkey, which, as the writer had shown in a previous communication to the Royal Society, is readily susceptible to the disease. The necessary small-pox material has been obtained during the course of recent outbreaks of small-pox at Middlesbrough, Glasgow and London.

The results of the experiments may be briefly summarised as follows:—In each of the separate series, the human small-pox lymph or pulp was first inoculated directly on calves, and in every instance, so far as could be observed, with altogether negative results. But with monkeys, success was as invariably obtained, and when, after one or more passages through this animal, the contents of the local inoculation vesicles were employed for insertion on the calf, an effect was now produced which, after two or three removes in that animal, was indistinguishable from typical vaccinia. Moreover, from the contents of vesicles raised in this manner on the calf, a number of children have been vaccinated, some of whom were afterwards kept under observation for a considerable period. Every such vaccination "took" normally, and in no case was any bad result subsequently observed.

The experimental results obtained all tend, then, to confirm the view that the vaccinia of Jenner's time was derived, in all probability, from a comparatively mild form of small-pox. Of even more importance is the fact that the work has afforded conclusive evidence of the essential identity of the virus of small-pox and cow-pox or vaccinia.

December 4.—"On the Vibrations and Stability of a Gravitating Planet" By J. H. Jeans, B.A., Isaac Newton Student and Fellow of Trinity College, Cambridge. Communicated by Prof. G. H. Darwin, F.R.S.

The first part of the paper deals with the vibrations and stability of a gravitating elastic sphere. The matter is not necessarily homogeneous, but is arranged in spherical layers. It is pointed out that, in the classical investigation of the displacements produced in a gravitating sphere by given surface-forces, the most important of the gravitational terms is omitted. The effect of this omission is to necessitate a correction, and this may entirely invalidate the solution when we are dealing with spheres of the size of the earth or other planets. In fact, it appears that for a gravitating solid of the kind we are discussing the spherical configuration may be one of *unstable equilibrium*, the instability being brought about by these gravitational terms. The vibration through which instability first enters is one in which the displacement at every point is proportional to a harmonic of the *first* order.

In a former paper, "The Stability of a Spherical Nebula" (*Phil. Trans.*, A, vol. cxcix., p. 1), the suggestion was put forward that the instability of a nebula, sun or planet, which, upon the nebular hypothesis, is supposed ultimately to result in the ejection of a satellite, may be largely brought about by a gravitational tendency to instability of the kind described. We take, for the moment, an extreme hypothesis, and imagine that this agency is the preponderating agency and that the rotational tendency to instability may be disregarded in comparison.

Except for the changes which have occurred since the consolidation of the planets, the solar system supplies material for testing the consequences of this hypothesis. When a number of planets of varying masses have thrown off satellites, we find (upon our present extreme hypothesis) that the masses ought to be proportional to the *squares* of the radii. It is found that this law is approximately obeyed in the solar system. It is further found that the absolute values of the masses and radii are approximately such as would be expected.

It is interesting to compare two extreme hypotheses, the first referring the phenomena of planetary evolution solely to rotational, the second solely to gravitational, instability. Given the approximate values of the density and elasticity of a planet, and the fact that this planet has thrown off a satellite, then the former hypothesis leads to a certain inference as to the angular momentum of the system, the latter to an inference as to the radius of the primary. The former leads to no inference at all as to the size of planets which are to be expected—they are as likely to be of the size of billiard balls as of the size of the planets of our system—while the latter leads to no inference as to the angular momentum of the system, but presupposes it to be small. The contention of the present paper is that the inferences which are drawn from the former hypothesis are not borne out by observation on the planets of our system, while those which are drawn from the latter are borne out as closely as could be expected. The true hypothesis must of necessity lie somewhere between the two extremes which are being